Institute of Energy and Mechanical Engineering
Department of Mechanical Engineering

EDUCATIONAL PROGRAM

6B07130 -"Mechanical Engineering and Modeling"

Code and classification of the field of education: 6B07 - Engineering, manufacturing and construction industries
Code and classification of training areas: 6B071 - Engineering and Engineering
Group of educational programs: B064 - «Mechanics and metal working»
Level based on NQF: 6B
ORC Level:6
Study period: 4 years
Amount of credits: 240

Almaty 2023

Educational program 6B07130 - Mechanical Engineering and Modeling approved at the meeting of the Academic Council of Kazntu named after K.I.Satpayev.

Protocol no. ___ from "___" _____2023 g.
Reviewed and recommended for approval at a meeting of the Educational and Methodological Council of Kazntu named after K.I.Satpayev.

Protocol no. ___ from "___" _____ 2023 g.
Educational program 6B07130 - Mechanical Engineering and Modeling developed by the academic committee for the group of educational programs:
B064 - Mechanics and metal working

Full name	Academic degree/ academic title	Position	Workplace	Signature
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List of abbreviations and designations

EP - educational program,
LO – learning outcomes,
FM– Fluid Mechanics

1. Description of the educational program

The educational program **"Mechanical Engineering and Modeling"** is aimed at preparing bachelors able to solve a wide range of engineering problems of mechanics based on fundamental knowledge in mathematics, mechanics, physics, chemistry and engineering principles using modern analytical, experimental and numerical methods mathematical and computer modeling and information technology. During preparing students, a broad systematic approach is followed, when graduates will make engineering decisions with a full understanding of the possibilities and limitations of research methods and advanced technologies used.

Thus, the mission of the educational program Mechanical Engineering and Modeling is to provide the market with highly qualified specialists with fundamental knowledge in the fields of natural sciences, engineering mechanics and computer modeling to work in the field of high-tech engineering.

The curriculum of the educational program “Mechanical Engineering and Modeling” is developed in accordance with the curricula of the educational program “Mechanical Engineering” of the world best research and engineering universities such as Massachusetts Institute of Technology – MIT, Stanford University, University of Cambridge, Georgia Institute of Technology, Technical University of Munich, Pennsylvania State University, Tokyo University, Nanyang Technological University (Singapore), and others, taking into account the current trends in technology development.

In the course of training, special attention is paid to the acquisition by graduates of in-depth knowledge in relevant areas of mathematics, the laws of physics and mechanics underlying modern engineering design, numerical and computer modeling methods and information technologies. The basic education received in these areas will allow future specialists to easily integrate into the workflow of almost any industry, it is easy enough to master a wide range of new technologies.

During the first two courses (in the first 4 semesters), students have the opportunity to receive fundamental education in mathematics (differential and integral calculus, vector analysis, algebra and geometry, differential equations, partial differential equations), physics (molecular physics, thermodynamics, electricity and magnetism, optics and atomic physics), mechanics (statics, strength of materials, dynamics), chemistry, information and digital technologies (information and communication technologies, numerical methods and programming), Kazakh and English languages. This knowledge is the basis of any technology and will allow students who have mastered them to easily master new technologies and retrain for other modern specialties.

At senior courses, students study in-depth special courses in mechanics and engineering (engineering thermodynamics, engineering materials, fluid mechanics, solid mechanics, theory and design of mechanisms and machines, design of machine elements, fundamentals of heat and mass transfer, numerical methods for solving engineering problems, fundamentals of robotics, design of mechanical systems and

elective courses) and gain skills at numerical and computer modeling, design of machine elements and structures, design of mechanisms and mechanical systems, numerical modeling and research of various mechanical processes and phenomena, development and creation of robots and manipulators. Primary attention is paid to the acquisition by graduates of skills in developing computer models of various engineering tasks and hydraulic systems, complex mechanical, thermal or mass transfer processes in various industries using modern computing and information technologies.

Students will practice in such companies as Kazatomprom JSC, Kazmunaygas JSC, at the Institute of Mechanics and Machine Science, at the Institute of Mathematics and Mathematical Modeling, etc. Students have the opportunity to undergo an internship at leading engineering universities in Europe and Russia could under the academic mobility program.

The educational program will make it possible to implement the principles of the Bologna process. Based on the students' choice and independent planning of the sequence of studying disciplines, they independently form an individual study plan for each semester according to the curriculum and the catalog of elective disciplines.

During the study teaching is conducted by highly qualified teaching staff, including graduates of USA, Europe, Russia and other countries universities.

Graduates can choose different career paths. They can either work in industry as practicing engineers or pursue master studies in mechanical engineering or applied sciences. Many graduates go on to careers in business or in public activities. The best graduates have studied or are studying in master's or doctoral studies at KazNU, NU, Purdue University, Georgia Institute of Technology, National University of Singapore, University of Pittsburgh, University of Lorraine and many other universities.

The Bachelor's degree program "Engineering Mechanics and Modeling" is the first level of qualification of a three-level system of higher education, it lays the foundation for subsequent master and later doctoral programs.

2. Purpose and objectives of educational program

The purpose of the educational program **" Mechanical Engineering and Modeling"** is to train highly qualified personnel: possessing fundamental knowledge of mechanics, mathematics, physics, chemistry, as well as methods and IT skills for modeling problems of engineering mechanics; able to apply knowledge and skills for the development and design of new mechanisms and mechanical devices, mechanical, thermal and hydraulic systems, heat- and mass transfer devices and installations, robots and manipulators; able to use knowledge to manage modern technological processes in mechanical engineering and energy.

Areas of professional activity of the graduate

profession	Labor function A scientific	Professional task A1: develop modern mechanical systems, mechanisms and mechanical devices, and robots	Knowledge Calculus I-III, ODE, Strength of materials, Solid Mechanics, Theory and Design of Mechanisms and Machines, Numerical Methods and Programming, Design of Machine Elements, Design of Mechanical Systems, Introduction to Robotics.
			Skills Ability to work with high-tech laboratory and research equipment. The ability to develop new mechanisms and devices, including robots.
			Standards of behavior: Self-learning and systemic thinking; IT competencies; creativity; cooperation with team members; ability to make decisions quickly, respond to changes in working conditions.
			Equipment and tools Computational systems, 3D printers, special materials and constructions, equipment for the study of mechanical properties of materials, electronic measuring systems, electrical equipment.
			Future trends The ability to develop effective mechanical structures and autonomous mechanical systems, and robots.
		Professional task A2:	Knowledge Calculus I-III, Linear Algebra and Analytical Geometry, Physics I-II, General Chemistry, Statics, Dynamics, ODE, Partial Differential Equations, Engineering Thermodynamics, Fluid Mechanics, Computational Methods and Programming, Object Oriented Programming, Fundamentals of Heat Transfer, Computational fluid mechanics and modeling, Modeling and design of thermal systems.

		develop efficient hydraulic and thermal systems, energy and mass transfer processes.	Skills Ability to work with high-performance computing systems, high-tech laboratory and research equipment. Ability to independently develop adequate physical and mathematical models of mechanical processes and phenomena. Ability to program in algorithmic languages, skills in modeling and research of complex mechanical and physical-chemical processes. Ability to use specialized software for independent study of a wide range of engineering problems in mechanics and design of various mechanical and energy systems.
			Standards of behavior: Self-learning and systemic thinking; IT competencies; creativity; cooperation with team members; ability to make decisions quickly, respond to changes in working conditions.
			Equipment and tools High-performance computing systems, specialized software and experimental installations for fluid mechanics, mass transfer devices and thermal systems, energy, research equipment.
			Future trends The ability to use machine learning methods to study stochastic problems of mechanics. The ability to use quantum computing systems to solve resource-intensive problems of fluid mechanics.
	Labor function B design and engineering	Professional task B1: design and create mechanisms and mechanical devices, mechanical systems and robots.	Knowledge Calculus I-III, ODE, Strength of Materials, Solid Mechanics, Numerical Methods and Programming, Theory and Design of mechanisms and machines, Design of Machine elements, Design of Mechanical Systems, Introduction to Robotics.
			Skills Ability to work with high-tech laboratory and research equipment. The ability to design and create new mechanisms and devices, including autonomous mechanisms and robots.
			Standards of behavior self-learning and systemis thinking; IT competencies; creativity; cooperation with team members; ability to make decisions quickly, respond to changes in working conditions.
			Equipment and tools 3D printers, computing systems, special materials and constructions, equipment for the study of mechanical properties of materials, electronic measuring systems, electrical equipment.
			Future trends

			The ability to design and create effective mechanical structures and autonomous mechanical systems, and robots.
		Professional task B2: develop mathematical models of physical and chemical processes in engines, heat exchangers and chemical reactors; design and build heat and mass transfer devices and reactors.	Knowledge Calculus I-III, Linear Algebra and Analytical Geometry, Physics I-II, General Chemistry, Statics, Dynamics, ODE, Partial Differential Equations, Engineering Thermodynamics, Fluid Mechanics, Numerical methods and programming, Object-oriented programming, Fundamentals of heat transfer, Computational fluid mechanics and modeling.
			Skills Ability to develop and create physical and mathematical models of mechanical and thermal phenomena and processes in engines, heat exchangers and chemical reactors. Ability to simulate and conduct experimental and numerical studies of fluid flow in pipes, channels of hydraulic systems, heat and mass transfer processes in thermal devices and reactors. Ability to design and build heat and mass transfer plants and reactors.
			Standards of conduct Self-learning and systemic thinking; IT competencies; creativity; cooperation with team members; ability to make decisions quickly, respond to changing working conditions.
			Equipment and tools High-performance computing systems and experimental installations for fluid mechanics, specialized software and experimental installations for fluid mechanics, mass transfer devices and thermal systems, energy, research equipment.
			Future trends Ability to design and create highly efficient heat and mass transfer installations and thermal energy storages
	Labor function C production, technological, organizational, managerial	Professional Task C1: manage of production and technological processes in	Knowledge Calculus I-III, ODE, Strength of Materials, Engineering Materials, General Chemistry, Fluid Mechanics, Solid Mechanics, Theory and Design of Mechanisms and Machines, Design of Machine Elements, Engineering Thermodynamics, Design of Mechanical Systems, Fundamentals of Heat Transfer.
			Skills Ability to model and program technological problems, skills in the study of complex physical and mechanical processes.

		mechanical engineering and energy	Knowledge of methodology: systemic analysis; design and decision-making in complex and professional situations; methods of communication and coordination of points of view; design and presentation of analytical and project documentation.
			Standards of conduct Self-learning and systemic thinking, technological literacy, entrepreneurship, customer orientation, the ability to make decisions quickly, respond to changes in working conditions, the ability to allocate resources and manage your time.
			Equipment and tools Equipment for mechanical engineering and energy.
			Future trends The ability to manage high-tech processes in mechanical engineering and energy.

3. Requirements for the evaluation of learning outcomes of the educational program

List of competencies

General competencies

- Knowledge of Kazakh, Russian and English languages for: free oral and written communication with a native speaker of a particular language on a professional topic and in a real-life situation; search for scientific and technical information in these languages; work with scientific and technical literature on engineering mechanics in these languages.
- Mastery of critical systemic thinking, transdisciplinarity and cross-functionality.
- Possession of IT competencies, the ability to develop software using algorithmic languages.
- Mastery of skills: self-study; deepening of one's knowledge; being open to new information; systemic thinking and one's own judgment.
- The ability to be tolerant of another nationality, race, religion, culture; the ability to conduct an intercultural dialogue.
- Possession of communication skills, the ability to cooperate and work in a team.
- Ability to work in cases of high uncertainty and rapid change of task conditions; to work with consumer requests.
- Possession of a broad social, political and professional outlook; ability to use data from various sources and specialized literature, analyze and critically evaluate historical facts and events.
- Knowledge of the basics of entrepreneurship and business economics, readiness for social mobility.

Professional competencies

- Possession of fundamental knowledge in mathematics, mechanics, physics and scientific principles and the ability to use them in solving engineering problems.
- Ability to independently develop adequate physical and mathematical models of mechanical and thermal processes and phenomena.
- Ability to use mathematical and computer models of mechanical processes for independent research of a wide range of engineering problems of mechanics and design of various mechanical and energy systems.
- The ability to develop new mechanisms and devices, including autonomous mechanisms and robots.
- Ability to work with high-tech laboratory and research equipment.
- Knowledge of algorithmic languages and programming technology using object-oriented programming, computer modeling skills and research of complex physical processes and engineering problems.
- Proficiency in working as a designer in mechanical engineering, energy, transport, chemical production.

- Knowledge of methodology: system analysis; design and decision-making in complex and professional situations; methods of communication and coordination of points of view; design and presentation of analytical and project documentation.

Learning outcomes

LO1 – to search and study scientific and technical information on mechanical engineering in Kazakh (Russian) and English;
LO2 – be able to express their opinions in written and orally on the topic of mechanical engineering in Kazakh (Russian) and English;
LO3 – critically analyze historical resources, know alternative ways of posing and solving ideological issues, possess the skills of independent analysis of socio-political issues, have an idea about entrepreneurship;
LO4 – programming in modern algorithmic languages, including object-oriented programming; possess modern computer design tools;
LO5 – differentiate and integrate functions of one and many variables; apply integral theorems and elements of tensor analysis in problems of fluid and solid mechanics;
LO6– to understand the fundamental physical phenomena and laws of the universe in order to apply them in the study of engineering problems;
LO7 – perform calculations on the dynamics of bodies, the theory of mechanisms and machines and machine parts based on knowledge of the theories of differential and integral calculus, vector analysis;
LO8 – to conduct research and calculations on deformations of bodies, heat and mass transfer processes in thermal devices and reactors based on knowledge of mathematical analysis, differential equations, numerical methods of solid mechanics and fluid mechanics;
LO9 – have the skills to apply modern software to determine the behavior of solids, fluid flow in pipes, channels and devices and use them to solve engineering problems;
LO10 – to develop physical and mathematical models of mechanical systems and thermal phenomena and processes in engines, heat exchange plants and chemical reactors;
LO11 – develop and design various mechanisms and machine parts, mechanical systems and devices, autonomous mechanisms and robots;
LO12 – to choose optimal numerical methods and develop, create software that allows to provide numerical calculations, modeling and research of mechanical, hydraulic and heat and mass transfer problems in pipes, channels and devices;
LO13 – conduct independent research using analytical, experimental or numerical methods to develop and design of new mechanical devices, robots, mass transfer or thermal devices.

Learning strategy

The strategy of the educational program **" Mechanical Engineering and Modeling"** is focused on training highly qualified specialists with fundamental

knowledge in the fields of natural sciences, engineering mechanics and computer modeling to work in the field of high-tech engineering applying modern trends of mechanical engineering.

During the training, special attention will be paid to the development skills at students to apply the methods of mathematical, numerical and computer modeling of engineering problems, the use of software for solving and researching various problems of engineering mechanics. To achieve this goal, the classes of almost all specialized disciplines includes both laboratory and practical classes, i.e. the theoretical knowledge of students is firmly anchored by the skills of their practical application.

In the course of students' Diploma project on the educational program, the main attention is paid to instilling in graduates the skills independently or in a team to develop physical or virtual models of sufficiently complex mechanical and physical-chemical processes and phenomena, to develop computer codes or apply modern softwares and on their basis to design energy and/or heat and mass transfer devices, mechanical systems and machines, robots and manipulators.

Possession of fundamental knowledge in the fields of natural sciences, engineering mechanics and computer modeling skills will allow graduates to integrate relatively easily into the workflow of almost any industry, it is easy enough to master a wide range of new technologies.

4. Passport of the educational program

educational programs **«6B07130 -Mechanical Engineering and modelling»**

4.1. General information

№	Title	
1	Code and classification of the field of education	6B07 Engineering, manufacturing and construction industries
2	Code and classification of the direction of training	6B071 Engineering and Engineering business
3	Group of educational programs	B064 Mechanics and metal working
4	Name of the educational program	6B07130 - **Mechanical Engineering and Modelling**
5	Short description	The educational program "Mechanical Engineering and Modeling" is aimed at preparing bachelors able to solve a wide range of engineering problems of mechanics based on fundamental knowledge in mathematics, mechanics, physics, chemistry and engineering principles using modern analytical, experimental and numerical methods mathematical and computer modeling and information technology. During preparing students, a broad systematic approach is followed, when graduates will make engineering decisions with a full understanding of the possibilities and limitations of research methods and advanced technologies used. Thus, the mission of the educational program Mechanical Engineering and Modeling is to provide the market with highly qualified specialists with fundamental knowledge in the fields of natural sciences, engineering mechanics and computer modeling to work in the field of high-tech engineering. The curriculum of the educational program “Mechanical Engineering and Modeling” is developed in accordance with the curricula of the educational program “Mechanical Engineering” of the world best research and engineering universities such as Massachusetts Institute of Technology – MIT, Stanford University, University of Cambridge, Georgia Institute of Technology, Technical University of Munich, Pennsylvania State University, Tokyo University, Nanyang Technological University (Singapore), and others, taking into account the current trends in technology development. In the course of training, special attention is paid to the acquisition by graduates of in-depth knowledge in relevant areas of mathematics, the laws of physics and mechanics underlying modern engineering design, numerical and computer modeling methods and information technologies. The basic education received in these areas will allow future specialists to easily integrate into the workflow of almost any industry, it is easy enough to master a wide range of new technologies. During the first two courses (in the first 4 semesters), students have the opportunity to receive fundamental education in mathematics

		(differential and integral calculus, vector analysis, algebra and geometry, differential equations, partial differential equations), physics (molecular physics, thermodynamics, electricity and magnetism, optics and atomic physics), mechanics (statics, strength of materials, dynamics), chemistry, information and digital technologies (information and communication technologies, numerical methods and programming), Kazakh and English languages. This knowledge is the basis of any technology and will allow students who have mastered them to easily master new technologies and retrain for other modern specialties. At senior courses, students study in-depth special courses in mechanics and engineering (engineering thermodynamics, engineering materials, fluid mechanics, solid mechanics, theory and design of mechanisms and machines, design of machine elements, fundamentals of heat and mass transfer, numerical methods for solving engineering problems, fundamentals of robotics, design of mechanical systems and elective courses) and gain skills at numerical and computer modeling, design of machine elements and structures, design of mechanisms and mechanical systems, numerical modeling and research of various mechanical processes and phenomena, development and creation of robots and manipulators. Primary attention is paid to the acquisition by graduates of skills in developing computer models of various engineering tasks and hydraulic systems, complex mechanical, thermal or mass transfer processes in various industries using modern computing and information technologies. Students will practice in such companies as Kazatomprom JSC, Kazmunaygas JSC, at the Institute of Mechanics and Machine Science, at the Institute of Mathematics and Mathematical Modeling, etc. Students have the opportunity to undergo an internship at leading engineering universities in Europe and Russia could under the academic mobility program. The educational program will make it possible to implement the principles of the Bologna process. Based on the students' choice and independent planning of the sequence of studying disciplines, they independently form an individual study plan for each semester according to the curriculum and the catalog of elective disciplines. During the study teaching is conducted by highly qualified teaching staff, including graduates of USA, Europe, Russia and other countries universities. Graduates can choose different career paths. They can either work in industry as practicing engineers or pursue master studies in mechanical engineering or applied sciences. Many graduates go on to careers in business or in public activities. The best graduates have studied or are studying in master's or doctoral studies at KazNU, NU, Purdue University, Georgia Institute of Technology, National University of Singapore, University of Pittsburgh, University of Lorraine and many other universities. The Bachelor's degree program "Engineering Mechanics and Modeling" is the first level of qualification of a three-level system

		of higher education, it lays the foundation for subsequent master and later doctoral programs.
6	EP's Goal	to train highly qualified personnel: possessing fundamental knowledge of mechanics, mathematics, physics, chemistry, as well as methods and IT skills for modeling problems of engineering mechanics; able to apply knowledge and skills for the development and design of new mechanisms and mechanical devices, mechanical, thermal and hydraulic systems, heat- and mass transfer devices and installations, robots and manipulators; able to use knowledge to manage modern technological processes in mechanical engineering and energy.
7	Type of EP	Bachelor Degree Program
8	The level of the NRK	6B
9	Sectoral Qualifications Framework Level	6
10	Distinctive features of the EP	Paying special attention to training in mathematics, mechanics, physics, modern information technologies and methods of analytical, experimental and numerical modeling and research, skills in developing physical, mathematical and computer models of complex mechanical and physical processes and engineering tasks. Graduates will have the opportunity to: use, along with methods of theoretical and experimental research of mechanics problems, methods of mathematical and computer modeling to solve engineering and technical problems; develop models of complex mechanical and physico-chemical processes and phenomena and create computer codes to solve them.
11	List of EP competencies	**General competencies** • Knowledge of Kazakh, Russian and English languages for: free oral and written communication with a native speaker of a particular language on a professional topic and in a real-life situation; search for scientific and technical information in these languages; work with scientific and technical literature on engineering mechanics in these languages. • Mastery of critical systemic thinking, transdisciplinarity and cross-functionality. • Possession of IT competencies, the ability to develop software using algorithmic languages. • Mastery of skills: self-study; deepening of one's knowledge; being open to new information; systemic thinking and one's own judgment. • The ability to be tolerant of another nationality, race, religion, culture; the ability to conduct an intercultural dialogue. • Possession of communication skills, the ability to cooperate and work in a team. • Ability to work in cases of high uncertainty and rapid change of task conditions; to work with consumer requests. • Possession of a broad social, political and professional outlook; ability to use data from various sources and specialized literature, analyze and critically evaluate historical facts and events.

		• Knowledge of the basics of entrepreneurship and business economics, readiness for social mobility. **Professional competencies** • Possession of fundamental knowledge in mathematics, mechanics, physics and scientific principles and the ability to use them in solving engineering problems. • Ability to independently develop adequate physical and mathematical models of mechanical and thermal processes and phenomena. • Ability to use mathematical and computer models of mechanical processes for independent research of a wide range of engineering problems of mechanics and design of various mechanical and energy systems. • The ability to develop new mechanisms and devices, including autonomous mechanisms and robots. • Ability to work with high-tech laboratory and research equipment. • Knowledge of algorithmic languages and programming technology using object-oriented programming, computer modeling skills and research of complex physical processes and engineering problems. • Proficiency in working as a designer in mechanical engineering, energy, transport, chemical production. • Knowledge of methodology: system analysis; design and decision-making in complex and professional situations; methods of communication and coordination of points of view; design and presentation of analytical and project documentation.
12	Learning outcomes of the EP	LO1 – to search and study scientific and technical information on mechanical engineering in Kazakh (Russian) and English; LO2 – be able to express their opinions in written and orally on the topic of mechanical engineering in Kazakh (Russian) and English; LO3 – critically analyze historical resources, know alternative ways of posing and solving ideological issues, possess the skills of independent analysis of socio-political issues, have an idea about entrepreneurship; LO4 – programming in modern algorithmic languages, including object-oriented programming; possess modern computer design tools; LO5 – differentiate and integrate functions of one and many variables; apply integral theorems and elements of tensor analysis in problems of fluid and solid mechanics; LO6– to understand the fundamental physical phenomena and laws of the universe in order to apply them in the study of engineering problems; LO7 – perform calculations on the dynamics of bodies, the theory of mechanisms and machines and machine parts based on knowledge of the theories of differential and integral calculus, vector analysis; LO8 – to conduct research and calculations on deformations of bodies, heat and mass transfer processes in thermal devices and

		reactors based on knowledge of mathematical analysis, differential equations, numerical methods of solid mechanics and fluid mechanics; LO9 – have the skills to apply modern software to determine the behavior of solids, fluid flow in pipes, channels and devices and use them to solve engineering problems; LO10 – to develop physical and mathematical models of mechanical systems and thermal phenomena and processes in engines, heat exchange plants and chemical reactors; LO11 – develop and design various mechanisms and machine parts, mechanical systems and devices, autonomous mechanisms and robots; LO12 – to choose optimal numerical methods and develop, create software that allows to provide numerical calculations, modeling and research of mechanical, hydraulic and heat and mass transfer problems in pipes, channels and devices; LO13 – conduct independent research using analytical, experimental or numerical methods to develop and design of new mechanical devices, robots, mass transfer or thermal devices.
13	Form of training	Full - time
14	Duration of training	4 years
15	Volume of credits	242
16	Language	Kazakh, Russian, English
17	Academic degree awarded	"Bachelor of Engineering and Technology" in the educational program "6B071xx - Mechanical Engineering and Modelling ".
18	Developers and authors	Prof. A. Kaltayev, assoc.prof. S.K. Japaev, assoc. prof. M.S. Tungatarova

4.2. The relationship between the achievability of the formed learning outcomes according to the educational program and academic disciplines

№	Name of disciplines	Brief description of the discipline	Number of credits	Generated learning outcomes (codes)												
				LO1	LO2	LO 3	LO4	LO5	LO6	LO7	LO8	LO9	LO10	LO11	LO12	LO13
Cycle of general education disciplines University component																
1	English - LNG108	**Purpose:** aimed to developing students' reading and listening as well as writing and speech skills, mastering pronunciation features and elementary vocabulary. **Summary** Fundamentals of English grammar, analysis of basic knowledge, use and memorization of the main grammar rules; lay a certain foundation for the students, which will improve their skills at the next stage of learning English.	10	✓	✓											
2	Kazakh (Russian) language LNG104	**Purpose:** to teach to understand texts on personal and professional topics containing the most frequent words and expressions; to be able to conduct a conversation on everyday topics; to describe your experiences and express your opinion. **Summary** to give a lexical and grammatical minimum, to acquaint with typical communicative situations, to evaluate them correctly and choose the appropriate model (strategy) of speech behavior; to teach the ability to use the language being studied, during the implementation of various types of speech activity.	10	✓	✓											
3	Information and Communication technology-CSE677	**Purpose:** training to use of modern information technologies in the field of professional activity. **Summary** The basic concepts of the architecture of computer systems, information and	5				✓					✓				

		communication technologies and subject terminology. Software interfaces of operating systems. Working with data in a different view. Basic principles of information security. Data formats and multimedia representation. Modern social, cloud and email platforms and how to work with them. Algorithmization and programming methods for solving engineering problems.														
4	History of Kazakhstan HUM101	**Purpose:** to familiarize students with the main achievements of the national historical science on the problems of the history of modern Kazakhstan, a comprehensive and systematic study of the main stages of the formation and development of Kazakh society. **Summary** The period from the beginning of the twentieth century till the present. The national liberation movement of the Kazakh intelligentsia at the beginning of the XX century, the period of the creation of the Kazakh SSR, as well as the process of formation of society.	5			✓										
5	Philosophy HUM132	**Purpose:** formation of cognitive, operational, communicative, self-educational competencies for the development of adequate ideological guidelines in the modern world. **Summary** "Philosophy" is the basis for the formation of a holistic worldview. The main paradigms of philosophy, classical and postclassical traditions of philosophy. The connection of philosophy with the development of stable life orientations, the acquisition of the meaning of being as a special form of spiritual production.	5			✓										
6	Module of socio-political knowledge (sociology, political science)-HUM120	**Purpose:** formation of systematic knowledge about the political sphere of public life, consistent and comprehensive study of the origins and evolution of the political thought of the Kazakh people at the stage of its historical development, political heritage and its most prominent representatives.	3		✓											
7	Module of socio-political	**Purpose:** to contribute to the formation of a holistic view of a person's personal	5		✓											

	knowledge (cultural studies, psychology) – HUM134	characteristics as a factor of success in mastering and implementing their educational and professional activities. **Summary** Mental processes, properties and conditions of a person in various fields of human activity, interpersonal and social interactions, ways and forms of their organization and changes when exposed.															
Cycle of general education disciplines Elective component																	
8	Fundamentals of anti-corruption culture – HUM133	**Purpose**: The discipline "Fundamentals of anti-corruption culture" is an important component and belongs to the number of social and humanitarian disciplines. **Summary** This discipline reveals the general patterns of the emergence, development and functioning of the anti-corruption culture, and organically related other social phenomena and processes.	5		✓												
9	Fundamentals of Entrepreneurship and Leadership – MNG488	**Purpose:** to teach to the students the theory and practice of entrepreneurship as a system of economic, organizational and legal relations of business structures. **Summary** The discipline is aimed at revealing the content of entrepreneurial activity, career stages, qualities, competencies and responsibilities of a modern entrepreneur, as well as theoretical and practical business planning and economic expertise of business ideas.The students could develop their leadership and teamwork skills.	5		✓												
10	Ecology and life safety – CHE656	**Purpose:** formation of concepts and ideas about the inseparable unity of effective professional activity with the requirements of human safety and security and environmental protection. The issues of ecology, life safety in working conditions are considered. **Summary** During the problematic seminars, the sources of atmospheric air pollution, surface, groundwater, soil and ways to solve environmental problems are considered; life safety in the technosphere; natural and man-made emergencies.	5		✓												

Cycle of basic education disciplines Вузовский компонент																
11	Calculus I-MAT 169	**The purpose** to introduce the basic ideas and concepts of mathematical analysis, to give basic knowledge of the differential calculus of a function of one variable. **Summary** Fundamentals of integral calculus of a function of one variable: definite integrals, indefinite integrals, the main theorem of integral calculus, properties of integrals, integration methods. Application of d calculus in mechanics and engineering.	5					✓		✓	✓					
12	Physics I: Molecular Physics. Thermodynamics - PHY469	**Purpose**: formation of ideas about the fundamental laws of mechanics and thermodynamics, as well as the molecular structure of bodies. **Summary** Newton's laws of mechanics and their applications in engineering. Molecular structures of bodies and their physical properties. Basic concepts and laws of thermodynamics.	5						✓							
13	Linear Algebra and Analytic Geometry - MAT189	**Purpose:** to provide basic knowledge on methods of solving algebraic equations and systems of linear equations, to introduce methods of analytical geometry on the plane and in space. **Summary** Determinants. Algebraic equations: general theorems. Decomposition and division of polynomials. Systems of equations. Matrices, algebra of matrices. Analytical geometry on a plane and in space.	5					✓		✓	✓					
14	Calculus II-MAT170	**Purpose**: to give students basic knowledge of the integral calculus of a function of one variable. **Summary** Fundamentals of integral calculus of a function of one variable: definite integrals, indefinite integrals, the main theorem of integral calculus, properties of integrals, integration methods. Application of integral calculus in mechanics and engineering.	5					✓		✓	✓					

15	Physics II: Electricity and Magnetism. Nuclearphysics - PHY471	**Purpose**: to provide basic knowledge on the laws of electromagnetism and their conscious application in science and technology. **Summary** Laws of electricity and magnetism, static electricity, electric currents, magnetic phenomena.	5						✓		✓					
16	Calculus III - MAT171	**Purpose:** to provide basic knowledge on differential and integral calculus of functions of many variables. **Summary** Differential and integral calculus of a function of many variables. Curvilinear, double and multiple integrals; surface and volume integrals; mean value theorems; Fourier series and integrals. Applications of differential and integral calculus of functions of many variables in mechanics and engineering.	5					✓		✓	✓					
17	Ordinary differential equations- MAT110	**Purpose**: formation of basic knowledge on the sections of the theory of ordinary differential equations (ODE), formulation of problems and methods of solutions. **Summary** 1st order ODE. The Cauchy problem. Higher orders ODE. ODE systems. Linear ODEs with variable coefficients. Numerical integration of ODEs and ODE systems. Numerical solution of ordinary differential equations with Matlab.	5								✓		✓	✓		
18	Calculus IV - MAT172	**Purpose**: to teach students fundamentals of vector analysis and elements of tensor analysis, mathematical statistics. **Summary** Fundamentals of vector analysis and elements of tensor analysis. Integral theorems. Applications of vector and tensor analysis in mechanics and engineering. Introduction to mathematical statistics.	5								✓		✓	✓		
19	Equations of mathematical physics – MAT448	**Purpose:** formation of basic knowledge on fundamentals of epartial differential equations, statements of their tasks and methods of solutions. **Summary**	5													

		Parabolic equations, properties and methods of their solutions, Fourier method. Hyperbolic equations, some properties and methods of their solutions, the method of characteristics. Elliptic equations and some qualitative properties, classical solutions, Poincare-Perron method.														
20	Engineering and computer graphics -GEN177	**Purpose:** to teach students the methods and means of machine graphics and graphical modeling of geometric objects. **Summary** Concepts of computer graphics, geometric modeling, graphic object, interactive graphic system for solving problems of automation of drawing and graphic works on the example of AutoCAD. Methods of obtaining certain graphical models of space based on orthogonal projection and the ability to solve problems related to spatial forms and relationships on these models.	5								✓		✓	✓		
21	Statics and Kinematics GEN409	**Purpose**: familiarization with various properties of forces and conditions of equilibrium, formation of foundations of the laws of nature related to the conditions of equilibrium of bodies. **Summary** A system of converging forces. The theory of moments. The main theorem of statics. Arbitrary plane system of forces. Friction. Arbitrary spatial system of forces. The center of gravity of the body. Kinematics of a point. The simplest movements of a rigid body. Plane-parallel motion of a rigid body. Complex point movement.	5							✓				✓		
22	Dynamics - GEN198	**Purpose**: familiarization with the main types of motion of mechanical systems and the formation of scientific foundations for the knowledge of the laws of nature related to the movement of material bodies under the action of forces. **Summary** The dynamics of a material point and the dynamics of a solid body. The basic laws of motion and interaction of material bodies. The	5							✓				✓		

		concept of oscillatory motion of various mechanical systems. Analysis of the conditions of stability of equilibrium and motion of material objects, methods for solving the corresponding equations.														
23	Chemistry - CHE495	**Purpose**: formation of knowledge on fundamental issues of general chemistry and skills of their application in professional activity. **Summary** Laws, theoretical propositions and conclusions that underlie all chemical disciplines; properties and relationships of chemical elements based on the Mendeleev's periodic law and on modern ideas about the structure of matter; fundamentals of chemical thermodynamics and kinetics; processes in solutions; the structure of complex compounds.	5						✓							
24	Theory and Design of Mechanisms and Machines - GEN413	**Purpose**: familiarization with general methods of analysis and synthesis of mechanical systems, mastering general methods of studying the structure, geometry, kinematics and dynamics of typical mechanisms and machines. **Summary** The basic concepts of machine elements and the main types of mechanisms. Structural analysis and synthesis of mechanisms. Kinematic analysis of mechanisms with lower pairs. Dynamics of machines and mechanisms. Synthesis of mechanisms. Designing mechanisms with the required properties.	5							✓			✓			
25	Engineering Thermodynamics GEN199	**Purpose**: familiarization with the basic laws and regulations of thermodynamics in relation to the tasks of power engineering and thermal power engineering. **Summary** Basic concepts of thermodynamics. The first law of thermodynamics. Application of the first law of thermodynamics to ideal gases. The second law of thermodynamics. Application of the second law of thermodynamics to analysis. Heat-power gas cycles. Thermodynamic potentials and differential equations of	5								✓		✓			

		thermodynamics. Properties of real gases and vapors. Cycles of refrigerating machines and heat pumps.														
26	Numerical Methods and Programming - GEN414	**Purpose:** introduction to the basics of programming, methods and algorithms of calculation, methods of numerical solution of algebraic and ordinary differential equations. **Summary** Algorithm, search algorithms, data processing algorithms, arithmetic algorithms. Examples of unstable algorithms and sensitivity of problems to initial conditions. Approximation of functions. Numerical differentiation and integration. Numerical solution of systems of algebraic equations. Numerical solution of ordinary differential equations by Euler and Runge-Kutta methods.	5								✓	✓				
27	Fluid Mechanics - GEN404	**Purpose**: formation of knowledge on fundamental issues of fluid mechanics and acquisition of skills in applying the knowledge and methods to solve practical engineering problems. **Summary** The continuity hypothesis; hydrostatics. Kinematics of the flow field; conservation of mass. Equations of fluid motion, Bernoulli's theorem. Vortex-free and vortex-free flow of incompressible inviscid fluid. Flows of viscous incompressible fluid. Turbulent flow, calculation methods.	5								✓	✓	✓		✓	
28	Solid Mechanics - GEN405	**Purpose:** formation of knowledge on the theoretical foundations of deformable solid mechanics, instilling skills in solving practical problems of mechanics and engineering. **Summary** Stress theory. Theory of deformations. The complete system of equations of the theory of elasticity. Methods for solving problems of elasticity theory. The simplest inversely symmetric problems of elasticity theory (torsion of rods). Approximate methods for solving problems of elasticity theory. Axisymmetric	5								✓	✓			✓	

		problems and non-axisymmetric problems. Theory of bending of thin plates.														
29	Computational fluid mechanics and modeling – GEN504	**Purpose:** training in calculus for solving mass and heat transfer equations and application to problems of engineering mechanics. **Summary** Fundamentals of finite difference methods. Finite-difference approximations of differential operators and equations. The concept of stability and convergence of the scheme. Methods for solving the vortex transfer equation. Methods for solving equations for the current function. Implementation of boundary conditions. Numerical methods for solving equations of fluid mechanics in variables "velocity-pressure".	5									✓	✓		✓	
30	Modeling and design of mechanical systems GEN-	**Purpose:** to gain knowledge in the field of engineering design of various types of mechanical systems on modern software. **Summary** The latest computer modeling tools, finite element methods, optimization methods and methods of analysis of many-body systems. Design of mechanical systems using standard packages and computer-aided design systems Stress calculation, evaluation of deflections, static failures, loss of stability of structural elements under combined loads.	5											✓	✓	
31	Modeling and design of thermal systems – GEN	**Purpose**: obtaining knowledge in the field of modeling and design of energy efficient thermal and ventilation systems. **Summary** Modeling and design of thermal systems. Optimization of thermal installations. Dynamic behavior of thermal systems. Heating systems based on renewable electricity. Solar heating and hot water supply. Economic calculations for engineering systems.	5										✓		✓	✓
Cycle of basic disciplines Elective component (Elective)																
32	Statistical Mechanics – GEN185	**Purpose:**study of the fundamentals of statistical mechanics and reliability theory, practical methods of their application. **Summary** Determination of probabilistic characteristics of processes, mastering statistical	5						✓				✓			

		methods for calculating systems, the main provisions of the theory of random processes, methods for analyzing random oscillations of mechanical systems, drawing up mathematical models for calculating machine elements, mechanisms and machine units under the action of random loads, carrying out calculations of reliability and trouble-free operation of systems.														
33	The Strength and Reliability of Machines - GEN407	**Purpose:** teaching the basics of the science of strength and reliability of materials, structures and machines, preparing him for the correct choice of calculation and design methods. **Summary** The main provisions of the strength of materials and structures, methods of calculation and design for the general case of the action of forces, calculation of statically indeterminate systems, dynamic action of forces, calculation of structural elements beyond the limits of elasticity, positions and dependences of reliability, reliability according to basic criteria, calculations of reliability of machine parts of individual groups.	5							✓	✓	✓				
Cycle of profile disciplines University component																
34	Strength of Materials - GEN426	**Purpose:** to teach the basics of materials' and structures' strength, rigidity and stability, to skills for correct choice of the methods for calculation and design of various structures. **Summary** The laws and theoretical propositions of the mechanics of a deformable solid. Methods of calculation of structural elements for strength, rigidity and stability, methods of calculation and design in the general case of the action of forces, dynamic action of forces, calculation of structural elements beyond elasticity.	5							✓	✓					
35	The finite element method in engineering- GEN441	**Purpose:** familiarization with the methodology of performing finite element analysis in the Structure3D automated control system environment. Mastering the creation of an object model in the APM Structure 3D editor and using the three-dimensional APM Studio editor. **Summary**	5							✓	✓					

		The basic concept of the FEM. Creation and calculation of models of structures containing rod, plate and volumetric finite elements in APM Structure 3D. Using APM Studio to create, load and generate a finite element grid of three-dimensional models. Modules for calculation, analysis and design of shafts and axles.														
36	Design of machine elements and parts -GEN	**Purpose:** formation of the initial knowledge on the basics of theory, design calculation, design of parts and elements of machines, development and design documentation. **Summary** The concept of parts and elements of machines, the main issues of ensuring their operability. Study of the general principles of design and construction, construction of models and calculation algorithms for typical parts and elements of machines, taking into account the main performance criteria, development of design skills.	5							✓				✓		
37	Basics of heat and mass transfer – GEN418	**Purpose**: formation of an idea about the physical nature of heat transfer processes, about theoretical, experimental and computational methods and methods for solving applied problems. **Summary** Basic concepts of heat transfer mechanisms. Fundamental principles and laws of heat transfer. The main types and models of heat transfer. The main methods and techniques for solving heat transfer problems in energy systems and their application to solve of practical engineering problems.	5							✓			✓	✓		
38	Introduction to Robotics--GEN421	**Objective**: to acquire skills in developing and programming models of kinematics, dynamics and sensing of robots, modeling, real-time control of robotic systems and manipulators. **Summary** Methods determination of the position and speeds of the robot links. Coordinate systems of the robot, recording the equations of forward and reverse kinematics of the robot. Recording	5											✓		✓

		of differential equations of robot motion, solution in Matlab. Control of the robot by trajectory and by force. Simulation of manipulators and robots.														
		Cycle of profile disciplines Component of choice														
39	Object-oriented programming-GEN503	**Purpose**: to give students of the basic principles of object-oriented programming (OOP) in C++ and C#. **Summary** Basic concepts. Classification of subspecies of OOP. Definition of OOP and its basic concepts. Implementation features. Program design in general. Various OOP methodologies. Component programming. Prototype programming. Class-oriented programming.	4								✓	✓	✓		✓	✓
40	Dynamics of machines and its computer analysis-GEN159	**Purpose**: formation of bases of the dynamic processes including its design during the operation of machines and mechanisms. **Summary** Equivalent circuits and mechanical characteristics of machines and their drives. Laws of motion of machines with various mechanical characteristics. The theory of dynamics of machines with concentrated and distributed parameters. Ways to reduce dynamic loads. Computer analysis and synthesis of dynamic systems using the MATHCAD mathematical package.	5							✓		✓		✓		✓
41	Dynamic systems management-GEN189	**Purpose**: to teach the fundamentals of control of dynamic systems. **Summary** Theory of control of technical objects, challenges dictated by the nonlinear dynamics of management processes, priority tasks and approaches to their solution. The development of control theory in the context of three periods of its formation: the period of classical Newton mechanics, the modern period and in the direction of the future role of control theory as a component of the process of creating self-managed objects and technologies.	5							✓				✓		✓

42	Machine learning and data analysis - GEN	**Purpose**: to familiarize with the basics of machine learning and its application in stochastic engineering problems. **Summary** Linear classifier and stochastic gradient. Neural networks: gradient optimization methods. Metric methods of classification and regression. The method of support vectors. Multidimensional linear regression. Nonlinear regression. Model selection criteria and feature selection methods. Logical classification methods. Deep neural networks. Neural networks with unsupervised learning.	5									✓			✓	✓
43	3D printing of machine parts and elements – GEN438	**Purpose**: to familiarize students with the basics of additive technology and the main types of AM technologies. **Summary** The study of terminology and classification, characteristics of the AM technology market. Additive technologies and rapid prototyping, technologies and machines for growing metal products. Additive technologies and foundry, additive technologies and powder metallurgy, creation of machine elements.	6											✓		✓
44	Mechanics of biofluids-GEN442	**Objective**: to study the structure, function and movement of mechanical aspects of biological systems using methods of mechanics. **Summary** Rheological properties of blood and issues of its modeling, biomechanics of large blood vessels, anatomy and histology of vessels, mechanical properties of biological tissues, features of the functioning of the vascular system in a living organism. Research and modeling methods.	6									✓			✓	✓
45	Design of thermal and ventilation systems – GEN445	**Purpose**: obtaining knowledge in the field of designing energy efficient thermal and ventilation systems. **Summary** Design of thermal and ventilation systems: Modeling of thermal and ventilation systems. Optimization of thermal and ventilation installations. Dynamic behavior of thermal and ventilation systems. Economic calculations for	6											✓	✓	✓

		engineering systems.														
46	Renewable energy systems - GEN446	**Purpose**: formation of knowledge in the field of renewable energy sources and training in the skills of its usage. **Summary** The volume of reserves of traditional energy sources. Nuclear energy and the greenhouse effect. Solar radiation. Wind energy. Water energy. Geothermal energy. Usage of biomass. Hydrogen production, fuel cells and methanization.	6						✓				✓		✓	✓

4.4 Information about disciplines

№	Name of the discipline	Brief description of the discipline	Number of credits	Emerging competencies
Cycle of general education disciplines University component/Component of choice				
	Englishlanguage	**The purpose of the course** "Beginner English" is learning from scratch- the foundation of learning English. This course is also suitable for those who have only general elementary knowledge of the language, to teach them to communicate on basic topics in English. **Course** "ElementaryEnglish" is aimed at developing students' receptive skills (reading and listening) and productive skills (writing and speaking), mastering pronunciation features and elementary vocabulary. **Summary of the discipline.** Basics of English grammar, to lay a certain foundation for the student, which will allow him to improve his skills at the next stage of learning English by analyzing basic knowledge, using and memorizing the main grammatical rules.	1	Mastering the peculiarities of pronunciation and elementary vocabulary. Ability to communicate verbally on basic topics in English. The ability to communicate in writing on basic and professional topics in English using a dictionary. Ability to work with sources and scientific and technical information on engineering mechanics in English
	Kazakh (Russian) language	**The purpose of the course is**to teach students to listen to statements on well-known topics related to home, study, free time; understand texts on personal and professional topics containing the most frequent words and expressions; be able to conduct a conversation on everyday topics; describe your experiences; express your opinion.**Summary of the discipline.** The course material is selected in such a way that the student, assimilating the lexical and grammatical minimum, had the opportunity to get acquainted with typical communicative situations and find himself in such situations, was able to correctly evaluate them and choose the appropriate model (strategy) of speech behavior. The main focus of learning is transferred from the process of knowledge transfer to learning the ability to use the language being studied, the ability to carry out various types of speech activity.	10	Acquisition of reading, writing and understanding skills of sounding speech on the basis of simultaneous mastering the basics of grammar (phonetics, morphology and syntax) and word usage. The ability to conduct a conversation on everyday topics; describing one's experiences; expressing one's opinion; retelling and evaluating the content of a book read, a movie seen. The ability to create simple texts on well-known topics, including those related to professional activity.
	Informationandcommunicationtechnologies	**The purpose of the** course is to teach the skills of using modern information technologies in the field of professional activity. **Summary of the discipline.** The basic concepts of the architecture of computer systems, information and communication technologies and subject terminology. Software interfaces of operating systems. Working with data in a different view. Basic principles of information security. Data formats and multimedia content.Modern social, cloud and email platforms and ways to work with them. Algorithmization and programming methods for solving engineering problems.	5	Ability: work with interfaces of modern operating systems; work with modern application software for working with data of various nature and purpose; apply modern social, cloud, and email platforms to organize business processes; programming in an algorithmic programming language.

	Modernhistoryo fKazakhstan	**The purpose of the** course is to familiarize students with the main achievements of the national historical science on the problems of the history of modern Kazakhstan, a comprehensive and systematic study of the main stages of the formation and development of Kazakhstan society. **Summary of the discipline.** The course covers the period from the beginning of the twentieth century to the present day. The modern history of Kazakhstan studies the national liberation movement of the Kazakh intelligentsia at the beginning of the XX century, the period of the creation of the Kazakh ASSR, as well as the process of formation of a multinational society.	5	Ability: work with all kinds of historical sources; writing essays and scientific articles on the history of the Fatherland; to operate with historical concepts; to conduct a discussion. Possession of skills of independent analysis of historical facts, events and phenomena; public speech.
	Sociology/ Political Science	**Purpose:** formation of systematic knowledge about the political sphere of public life, consistent and comprehensive study of the origins and evolution of the political thought of the Kazakh people at the stage of its historical development, political heritage and its most prominent representatives.		
	Cultural Studies/ Psychology	**Purpose:** to contribute to the formation of a holistic view of a person's personal characteristics as a factor of success in mastering and implementing their educational and professional activities. **Summary** Mental processes, properties and conditions of a person in various fields of human activity, interpersonal and social interactions, ways and forms of their organization and changes when exposed.		
	Fundamentals of anti-corruption culture, ecology and life safety	**Purpose:** The discipline "Fundamentals of anti-corruption culture" is an important component and belongs to the number of social and humanitarian disciplines. **Summary** This discipline reveals the general patterns of the emergence, development and functioning of the anti-corruption culture, and organically related other social phenomena and processes.		
	Philosophy	**The purpose of the** course is the formation of cognitive, operational, communicative, self-educational competencies to develop adequate ideological guidelines in the modern world; to distinguish between spiritual and material values, to determine one's attitude to life and to search for harmony with the surrounding world. **Summary of the discipline.** "Philosophy" is the basis for the formation of a holistic worldview. The main paradigms of philosophy and classical and postclassical traditions of philosophy. The connection of philosophy with the development of stable life orientations, the acquisition of the meaning of being as a special form of spiritual production.	5	Ability: analyze the history of the development of philosophical thought; to identify alternative ways of posing and solving ideological issues in the history of human development; to identify the main theoretical approaches in the relationship of a person with society.
Cycle of basic disciplines - University component				
	Mathematicalanaly sisI	**Purpose of the course:**to acquaint students with the basic ideas and concepts of mathematical analysis, to give basic knowledge of the differential calculus of a function of one variable. **Summary of the discipline.** Basic concepts of mathematical analysis: functions, variables, limits, series, derivatives.Basic concepts and rules of differential calculus of a function of one variable.Applications of differential calculationfunctions of one variable in mechanics and engineering.	5	**The ability** to find:the limits of continuous functions, the derivative of elementary functions of one variable, higher-order derivatives of a function of one variable; to investigate the functions of one variable using a derivative; to use for solving problems of **mechanics and engineering.**

	Mathematical analysis II	**Purpose of the course:**to give students basic knowledge of integral calculus of a function of one variable. **Summary of the discipline.** Fundamentals of integral calculus of a function of one variable: definite integrals, indefinite integrals, the main theorem of integral calculus, properties of integrals, integration methods. Applicationofintegralcalculusinmechanicsandengineering.	5	**The ability** to calculate integrals from elementary functions of one variable; to find indefinite and definite integrals from elementary functions of one variable; to find the length of an arc, the area of a curved trapezoid; to use in solving problems of mechanics and engineering.
	Mathematical analysis III	**The purpose of the course:** to give students basic knowledge of differential and integral calculus of functions of many variables. **Summary of the discipline.** Differential and integral calculus of a function of many variables. Partial derivatives; full differential; differentiation of a function of many variables; curvilinear, double and multiple integrals; integrals over the surface and over the volume; mean value theorems; disclosure of uncertainties; Fourier series and Fourier integrals. Applications of differential and integral calculus of functions of many variables in mechanics and engineering.	5	**Ability to calculate:** differentials of a function of many variables; integral of a function of many variables; curvilinear, double and multiple integrals; surface areas and volumes of figures and masses of bodies. It can be used to solve problems of mechanics and engineering.
	Mathematical analysis IV	**The purpose of the course:** to give students basic knowledge of vector analysis and elements of tensor analysis, mathematical statistics. **Summary of the discipline.** Fundamentals of vector analysis and elements of tensor analysis. Integral theorems. Applications of vector and tensor analysis in mechanics and engineering. Introductiontomathematicalstatistics.	5	**Ability to operate** scalar and vector functions; calculate the gradient of a scalar function, divergence and rotor of vector functions; use knowledge of vector analysis and elements of tensor analysis to solve problems of mechanics and engineering.
	Linear algebra and analytic geometry	**The purpose of the course:** to give students basic knowledge of methods for solving algebraic equations and systems of linear equations, to introduce methods of analytical geometry on a plane in space. **Summary of the discipline.** Determinants. Algebraic equations: general theorems. Polynomials. Systems of equations and methods of their solution. Matrices, algebra of matrices. Analytical geometry on a plane. Analyticalgeometryinspace.	5	Knowledge ofmethods of solving: algebraic equations of 1-4 degrees, systems of linear equations; operate with matrices. The ability to use the methods of analytical geometry to describe and study the problems of engineering mechanics.
	PhysicsI: Molecular physics. Thermodynamics	**The purpose of the** course is to form students' ideas about the fundamental laws of mechanics and thermodynamics, about the molecular structure of bodies. **Summary of the discipline.** Newton's laws of mechanics, applications in engineering. Molecular structures of bodies and their physical properties. Concepts and laws of thermodynamics.	5	**Possession of a system** of knowledge about the fundamental physical foundations and laws of mechanics and its theories, molecular physics and thermodynamics. The ability to apply this knowledge in solving problems of engineering mechanics.

	PhysicsII: Electricity and magnetism.	**Purpose of the course:**to give students basic knowledge of the laws of electromagnetism and their conscious application in science and technology. **Summary of the discipline.** Laws of electricity and magnetism, static electricity, electric currents, magnetic phenomena.	5	**Understanding** of the physical essence of the laws of electromagnetism and the ability to apply them in engineering and engineering. The ability to use methods of physical research to solve problems of mechanics.
	Ordinarydifferentialequations	**The purpose of the** course is to form basic knowledge on the sections of the theory of ordinary differential equations (ODES), problem statements and solution methods. **Summary of the discipline.** ODE of the 1st order. The Cauchy problem. An ODE of higher orders. ODE systems. Linear odes with variable coefficients. Numerical integration of ODES and ODE systems. UsingMatlabfornumericalsolutionofordinarydifferentialequations.	5	**Knowledge** of the basics and methods of solving ODES; the ability to build mathematical models of mechanics and engineering problems described by the ODE; the ability to solve problems described by the ODE using both analytical and numerical methods using Matlab.
	Equationsofmathematicalphysics	**The purpose of the** course is the formation of basic knowledge on the classical sections of mathematical physics equations, their problem statements and solution methods. **Summary of the discipline.** Parabolic equations, properties and methods of their solutions, Fourier method. Hyperbolic equations, some properties and methods of their solutions, the method of characteristics. Elliptic equations and some qualitative properties, classical solutions, Poincare-Perron method.	5	**Knowledge** of the concepts and ideas of the UMF; the ability to build mathematical models of simple engineering problems described by the UMF; the ability to select methods sufficient for their research and obtain analytical or numerical results.
	Engineeringandcomputergraphics	**The purpose of the** course is to teach students the methods and means of machine graphics and graphical modeling of geometric objects. Mastering the knowledge of drawing construction, the ability to read and compose graphic and textual design documentation. **Summary of the discipline.** Concepts of computer graphics, geometric modeling, graphic object, interactive graphic system for solving problems of automation of drawing and graphic works on the example of AutoCAD.Methods of obtaining certain graphical models of space based on orthogonal projection and the ability to solve problems related to spatial forms and relationships on these models. Building a drawing, reading and drafting graphic and textual design documentation.		Ability to apply methods of graphical representation of objects of engineering mechanics, mechanical engineering; willingness to use modern means of computer graphics, in engineering mechanics; ability to participate in the development of design and working design documentation in accordance with regulatory documents.
	Staticsandkinematics	**The aim of the course** is to familiarize students with various properties of forces and conditions of equilibrium and to form the scientific foundations of students' knowledge of the laws of nature related to the conditions of equilibrium and motion of material bodies. **Summary of the discipline.** A system of converging forces. The theory of moments. The main theorem of statics. Arbitrary plane system of forces. Friction. Arbitrary spatial system of forces. The center of gravity of the body. Kinematics of a point. The simplest movements of a rigid body.	5	The ability to apply fundamental laws of nature and basic physical laws in the field of mechanics to study static problems of engineering mechanics. Ability to build adequate mathematical models of static problems;

		Plane-parallel motion of a rigid body. Complexpointmovement. Complexmotionof a rigidbody.		Analyze the received decisions and draw conclusions and develop appropriate recommendations.
	Dynamics	**The purpose of the** course is to familiarize students with the main types of movement of mechanical systems and to form the scientific foundations of students' knowledge of the laws of nature related to the movement of material bodies under the action of forces. **Summary of the discipline.** The dynamics of a material point and the dynamics of a solid body. The basic laws of motion and interaction of material bodies. The concept of oscillatory motion of various mechanical systems. Analysis of the conditions of stability of equilibrium and motion of material objects, methods for solving the corresponding equations.	5	The ability to apply fundamental laws of nature and basic physical laws in the field of mechanics for the study of dynamic problems of engineering mechanics. The ability to build adequate mathematical models of dynamics problems. Ability and readiness to solve problems of dynamics by analytical and numerical methods. Ability and willingness to analyze the results obtained and summarize them.
	Generalchemistry	**The aim of the** course is to form students' knowledge on fundamental issues of general chemistry and skills of their application in professional activities. **Summary of the discipline.** Laws, theoretical propositions and conclusions that underlie all chemical disciplines; properties and relationships of chemical elements based on the periodic law of D.I.Mendeleev and on modern ideas about the structure of matter; fundamentals of chemical thermodynamics and kinetics; processes in solutions; the structure of complex compounds.	5	**Ability:** to navigate the basic concepts of chemistry, properties of elements-nonmetals and metals of groups of the periodic system; to make chemical equations describing mass transfer processes; make calculations using basic chemical patterns.
	Theory and design of mechanisms and machines	**The purpose of the** course is to familiarize students with the initial knowledge base on general methods of analysis and synthesis of mechanical systems underlying technological equipment, their development of general methods of studying the structure, geometry, kinematics and dynamics of typical mechanisms and machines. **Summary of the discipline.** The basic concepts of machine elements and the main types of mechanisms. Structural analysis and synthesis of mechanisms. Kinematic analysis of mechanisms with lower pairs. Dynamics of machines and mechanisms. Synthesis of mechanisms. Designing mechanisms with the required properties.	5	The ability to independently compile structural and kinematic schemes of mechanisms. Possession of general (standard) methods and algorithms for the analysis and synthesis of mechanisms and systems formed on their basis. Willingness to participate in the collection and analysis of initial data for the design of equipment elements and objects of activity in general using regulatory documentation and modern methods of information retrieval and processing.
	Engineeringthermodynamics	**The purpose of the** course is to familiarize students with the basic laws and regulations of technical thermodynamics in relation to the tasks of power engineering and thermal power engineering.	5	Skill and ability: to carry out thermodynamic

		Summary of the discipline. Basic concepts of thermodynamics. The first law of thermodynamics. Application of the first law of thermodynamics to ideal gases. The second law of thermodynamics. Application of the second law of thermodynamics to analysis. Heat-power gas cycles. Thermodynamic potentials and differential equations of thermodynamics. Properties of real gases and vapors. Cycles of refrigerating machines and heat pumps.		calculations of heat exchange systems; design and select heat supply systems for buildings and structures; perform thermal calculations on licensed software.
	Numericalmethods andprogramming	**The purpose of the** course is to familiarize students with the basics of programming, methods and algorithms of calculation, numerical methods for solving algebraic and ordinary differential equations, to teach them to use them to solve problems of mechanics, physics and engineering using computers. **Summary of the discipline.** Algorithms, data construction, arrays, search algorithms, data processing algorithms, arithmetic algorithms. Representation of numbers in the machine. Examples of unstable algorithms and sensitivity of problems to initial conditions. Approximation of functions. Numerical differentiation and integration. Numerical solution of systems of algebraic equations. Search for the minimum of functions. Numerical solution of ordinary differential equations.	5	Skill: to develop algorithms and programs for solving computational problems; numerically differentiate and integrate analytical or tabular functions; numerically find the roots of equations, the minimum of functions; numerically solve algebraic and systems of algebraic equations; Numerically solve ordinary differential equations by Euler and Runge-Kutta methods.
	Fluidandgasmech anics	**The purpose of the** course is to form students' knowledge on fundamental issues of fluid mechanics and the acquisition of skills in applying the knowledge and methods obtained to solve practical problems of mechanics and engineering. **Summary of the discipline.** Physical properties of media; continuity hypothesis; hydrostatics. Kinematics of the flow field; conservation of mass, vorticity distribution. Equations of fluid motion, Bernoulli's theorem. Vortex-free and vortex flow of incompressible inviscid fluid, examples. Viscous incompressible fluid flows, examples. Turbulentflow, calculationmethods.	5	Ability: to apply the basic laws of statics, kinematics and dynamics of liquids and gases in solving engineering problems; to distinguish between the modes of fluid flow and to select methods of solution in applied problems for the calculation of the movement of liquids and gases; independently build the appropriate calculation scheme and find the optimal solution to the task.
	Solidstatemechan ics	**The aim of the** course is to form students' knowledge of the theoretical foundations of deformable solid mechanics (MDTT), instilling in them the skills to solve practical problems of mechanics and engineering. **Summary of the discipline.** Stress theory. Theory of deformations. Physical equations. The complete system of equations of the theory of elasticity. Methods for solving problems of elasticity theory. The simplest inversely symmetric problems of elasticity theory (torsion of rods). Approximate methods for solving problems of elasticity theory. The plane problem of elasticity theory, application to concrete examples. Elementary solutions using the stress function.Axisymmetric problems and non-axisymmetric problems. Theoryofbendingofthinplates.	5	Ability: to determine stresses, deformations and displacements in a solid elastic body; make calculation schemes; make basic equations and apply methods of elasticity theory to solve applied problems; analyze the stress state at dangerous points and correctly apply the basic hypotheses of the classical theory of elasticity;
	Computationalhydr omechanicsandmo deling	**Purpose:** teaching methods of numerical solution of fluid flow problems arising in various engineering devices. **Summary**	5	Skill: to choose a method of numerical solution of a

		Fundamentals of finite difference methods and difference schemes. Methods for solving the vortex transport equation: explicit andimplicit schemes, a scheme with differences against the flow. Research on the stability of schemes. Setting boundary conditions. Numerical implementation of the solution of one- and two-dimensional vorticity transfer equation. Methods for solving equations for the current function. Difference schemes for elliptic type equations. Direct and iterative methods. The method of upper relaxation. Boundary conditions for the equation of the current function. Numerical implementation of the vorticity – current function equations. Finite–difference methods for solving the Navier–Stokes equations for physical variables.The MAC method and the projection method.Numerical implementation of boundary conditions.		specific problem of fluid mechanics, to set boundary conditions; build a numerical model of the problem; develop a computer program and perform calculations; analyze the results and validate the model, if necessary, make adjustments to the numerical and/or computer models.
	Modeling and design of mechanical systems	**The aim of the** course is to gain students' knowledge in the field of engineering design of various types of mechanical systems using modern computer programs. **Summary of the discipline.** The course combines a wide range of design tools necessary for a mechanical engineer. Classical engineering disciplines are combined with courses on the latest computer modeling tools, such as finite element methods, optimization methods and methods for analyzing systems of many bodies. The issues of using various kinds of computer programs in engineering design are considered. Stress calculation, evaluation of deflections, static failures, loss of stability of structural elements under combined loads are carried out.	5	Having the ability to solve standard problems of engineering mechanics. Ability to model technical objects and technological processes. Knowledge of the methodology for designing mechanical systems using standard packages and computer-aided design tools and the ability to apply them in practice. The ability to use new knowledge and skills in practical activities.
	Modeling and design of thermal systems	**The purpose of the** course is to provide students with knowledge in the field of thermal system design, to form their knowledge on the design and definition of energy efficient, environmentally friendly and economically cost-effective thermal installations. **Summary of the discipline.** Modeling of thermal systems. System modeling of thermal installations. Optimization of thermal installations. Mathematical modeling-thermodynamic parameters. Dynamic behavior of thermal systems. Modeling using methods of probability theory. Solar heating and hot water supply. Heatingsystemsbasedonrenewableelectricity.	5	Ability to apply mathematical methods in system modeling of thermal installations; apply modern computer technologies and programs for calculation and selection of thermal systems; apply TRNSYS and EES software in the calculation and selection of component equipment for thermal systems; designthermalsystems.
		Cycle of basic disciplines - Elective component		
	Statistical mechanis	**The aim of the** course is to form students' scientific foundations of a probabilistic approach to the calculation of structural elements for strength, reliability, stability. Study of the fundamentals of statistical mechanics and reliability theory and practical methods of their application. Preparation for the possible use of the described methods in the practice of designing and developing devices, machines and structures in various fields of industry. **Summary of the discipline.** Determination of probabilistic characteristics of processes, development of statistical methods for calculating systems, the main provisions of the theory of random processes, methods for analyzing random fluctuations of mechanical systems, compilation of	5	Ability to perform calculations of reliability and uptime of systems; determine the probability of failure-free operation of mechanical systems; formulate your own conclusions and justify them. Ability and willingness to apply practical methods of

		mathematical models for calculating machine elements, mechanisms and machine units under the action of random loads, calculations of reliability and trouble-free operation of systems, methods for calculating strength reliability and fatigue durability.		the fundamentals of statistical mechanics and reliability theory; use the studied material in your subject area; use information technology to solve problems of statistical mechanics; analyze the results obtained and summarize them.
	Strength and reliability of machines	**The purpose of the course:** to teach the future engineer the basics of the science of strength and reliability of materials, structures and machines, to prepare him for the correct choice of calculation and design methods. **Course Description:**the main provisions of the science of the strength of materials and structures, methods of calculation and design for the general case of the action of forces, calculation of statically indeterminate systems, dynamic action of forces, calculation of structural elements beyond the limits of elasticity, positions and dependences of reliability, reliability by basic criteria, calculations of reliability of machine parts of individual groups.		Ability to design structures of machines and mechanisms; to analyze the necessary information, technical data, indicators and results of work, their generalization and systematization; to carry out the necessary calculations using modern technical means when calculating the strength and reliability of machines.
Cycle of profile disciplines University component				
	Strengthofmaterials	**The purpose of the** course is to teach the future engineer the basics of the science of strength, rigidity and stability of materials and structures, to prepare him for the correct choice of calculation methods and design of various structures, to develop students' logical thinking, independent thinking skills necessary in further work when solving certain problems of natural science and technology. **Summary of the discipline.** The laws and theoretical propositions that underlie the mechanics of a deformable solid. Methods of calculation of structural elements for strength, rigidity and stability, methods of calculation and design in the general case of the action of forces, the dynamic action of forces, calculation of structural elements beyond elasticity.	5	Proficiency in the experimental study of the mechanical properties of materials, the stress-strain state of the simplest structural elements. Ability to handle modern testing machines and measuring equipment; accurately and thoroughly argue the course of reasoning, without cluttering it with unnecessary details; apply the studied material in various fields of engineering.
	The finite element method in engineering	**Purpose:** to familiarize with the methodology of performing finite element analysis in the Structure3D automated control system environment. Mastering the creation of an object model in the ARM Strucmrc3D editor and using the three-dimensional ARM Studio editor. **Summary** The basic concept of the FEM. Creation and calculation of models of structures containing rod, plate and volumetric finite elements in ARM Structure 3D. Using ARM Studio to create, load and generate a finite element grid of three-dimensional models. Modules for calculation, analysis and design of shafts and axles.		
	Design of machine elements and parts	**The purpose of the** course is to form the necessary initial knowledge base for students on the basics of theory, design calculation, design of parts and elements of machines, development and design documentation. Development of knowledge, skills and selection skills, analysis of joints,	5	Ability design elements of machines of the required purpose according to the specified output data;

		bearings, shafts, gears and other machine elements, as well as their design using computer technology. **Summary of the discipline.** The concept of parts and elements of machines, the main issues of ensuring their operability. Study of the general principles of design and construction, construction of models and calculation algorithms for typical parts and elements of machines, taking into account the main performance criteria, development of design skills.		choose the most suitable materials for machine elements and use them efficiently;perform calculations of machine parts and components using reference literature and GOST standards. The ability to collect and analyze raw data for the design of machine elements using regulatory documentation and methods of information retrieval and processing.
	Basics of heat and mass transfer	**The aim of the** course is to form students' understanding of the physical nature of heat transfer processes, theoretical, experimental and computational methods used in the study of these processes, methods for generalizing the results obtained, as well as skills for solving applied problems. **Summary of the discipline.** Basic concepts of heat transfer mechanisms. Fundamental principles and laws of heat transfer.The main types and models of heat transfer. The main methods and techniques for calculating heat transfer in energy systems and their application to solve problems of engineering practice.	5	Ability to carry out calculations of the thermal state of structural elements of thermal power devices; identify, formulate and solve problems related to heat transfer; perform calculations of heat transfer in energy systems; independently build a calculation scheme and find the right solution to the task.
	IntroductiontoRobotics	**The aim of the** course is to teach students the basic methods of robotics and automation, to acquire the skills of writing equations and programming in the Matlab kinematics, dynamics and robot sensing system, simulation, real-time control of real robotic systems and manipulators (in the Matlab system). **Summary of the discipline.** Study of different types of robots. Methods determination of the position and speeds of the robot links. Coordinate systems of the robot, writing equations of forward and reverse kinematics of the robot, solution in the Matlab system. Recording of differential equations of robot motion, solution in the Matlab system. Control when the robot moves along the trajectory. Management by force. The use of various sensors in robots. Simulation of manipulators and robots.		The ability to apply methods for determining the position and speed of robot links in the Matlab environment, for calculating and designing robots. Willingness and ability to use information technologies, including modern computer tools, in robotics. The ability to design new works in mechanical engineering.
	Cycle of profile disciplines Component of choice			
	Object-orientedprogramming	**Purpose:** to give students an idea of the basic principles of object-oriented programming (OOP) in C++ and C#. **Summary** Basic concepts. Classification of subspecies of OOP. Definition of OOP and its basic concepts. Implementation features. Program design in general. Various OOP methodologies. Component programming. Prototypeprogramming. Class-orientedprogramming.		
	Dynamics of machines and its computer analysis	**The purpose of the** course is to form ideas about the dynamic processes that take place during the operation of machines and mechanisms and take them into account when designing. **Summary of the discipline.** Equivalent circuits and mechanical characteristics of machines and their drives. Laws of motion of machines with various mechanical characteristics. Questions of the theory of dynamics of machines with concentrated and distributed parameters**.** Ways to reduce		The ability to apply theoretical, computational and experimental research methods, methods of mathematical and computer modeling in the process of professional activity.

		dynamic loads. Computer analysis and synthesis of dynamic systems using the MATHCAD mathematical package.		Knowledge of modern methods and means of conducting experimental research on dynamics and strength, stability, reliability, friction and wear of machines and devices.
	Engineeringmaterials	**The purpose of the** course is to familiarize students with the structure and mechanical properties of metallic and non-metallic materials. **Summary of the discipline.** The structure of materials. Crystallization and structure of metals and alloys. Mechanical properties of materials. Diagram of the state of alloys. Structure, properties of heat treatment of iron-carbon alloys. Structural and tool steels are alloys. Non-ferrousmetalsandnon-metallicmaterials.		Knowledge of methods: determination of optimal and rational modes of heat treatment and hardening of materials; analysis of the causes of defects in materials; determination of the quality and condition of alloys based on the analysis of their structures.
	Machine learning and data analysis	**Purpose:** to familiarize with the basics of machine learning and its application in stochastic engineering problems. **Summary** Linear classifier and stochastic gradient. Neural networks: gradient optimization methods. Metric methods of classification and regression. The method of support vectors. Multidimensional linear regression. Nonlinear regression. Model selection criteria and feature selection methods. Logical classification methods. Deep neural networks. Neural networks with unsupervised learning.		
	3D printing of machine parts and elements	**Purpose:** to familiarize students with the basics of additive technology and the main types of AI technologies. **Summary** The study of terminology and classification, characteristics of the AM technology market. Additive technologies and rapid prototyping, technologies and machines for growing metal products. Additive technologies and foundry, additive technologies and powder metallurgy, creation of machine elements.		
	Fundamentalsofmechatronics	**Purpose of the course:**to acquaint bachelors with the basics of microcontrollers, analog and digital electronics, sensors, actuators and their application in modern mechatronic systems, with mathematical methods and algorithms used in planning and controlling movement under the influence of force, as well as to instill some skills in the use of these methods. **Summary of the discipline.** Fundamentals of mechatronics: 16-bit microprocessor, embedded computers, analog and digital devices, sensors, actuators.Modeling and control of electromechanical systems, modeling of various mechatronic systems.		The ability and ability to design, model and manage modern mechatronic systems.
	Renewableenergy systems	**Purpose:** formation of knowledge in the field of renewable energy sources and training in the skills of their use. **Summary** The volume of reserves of traditional energy carriers. Nuclear energy and the greenhouse effect. Solar radiation. Wind energy. Water energy. Geothermy. Use of biomass. Hydrogenproduction, fuelcellsandmethanization.		

5. Curriculum of educational program

of Educational Program on enrollment for 2023-2024 academic year

Educational program 6B07130 - "Engineering mechanics and modeling"

Group of educational programs in 064 - "Mechanics and metalworking"

Form of study: full-time **Durationofstudy: 4 years** **Academic degree: Bachelor of Engineering and Technology**

Discipline code	Name of disciplines	Cycle	Total amount in credits	Total hours	classroom volume of lek/lab/pr	SIS (including TSIS) in hours	Form of control	Allocation of face-to-face training based on courses and semesters							
								I course		II course		III course		Ivcourse	
								1 term	2 term	3 term	4 term	5 term	6 term	7 term	8 term
CYCLE OF GENERAL EDUCATION DISCIPLINES (OOD)															
M-1. Language Training module															
LNG 108	English language	GED, RC	10	300	0/0/6	210	E	5	5						
LNG 104	Kazakh (Russian) language	GED, RC	10	300	0/0/6	210	E	5	5						
M-2. Physical training module															
KFK 101-104	Physical Culture	GED, RC	8	240	0/0/8	120	Difcredit	2	2	2	2				
M-3. Information Technology module															
CSE 677	Information and communication technologies (in English)	GED, RC	5	150	2/1/0	105	E				5				
M-4. Module of socio-cultural development															
HUM 137	History of Kazakhstan	GED, RC	5	150	1/0/2	105	SE		5						

HUM 132	Philosophy	GED, RC	5	150	1/0/2	105	E				5				
HUM 120	Module of socio-political knowledge (sociology, political science)	GED, RC	3	90	1/0/1	60	E				3				
HUM 134	Module of socio-political knowledge (cultural studies, psychology)		5	150	2/0/1	105	E			5					
M-5. Module fundamentals of anti-corruption culture, ecology and life safety															
HUM 136	Fundamentals of Anti-Corruption Culture and Law	GED, CCH	5	150	2/0/1	105	E			5					
MNG 489	Fundamentals of Economics and Entrepreneurship														
MSM500	Scientific research methods														
CHE 656	Ecology and life safety														
CYCLE OF BASIC DISCIPLINES (DB)															
M-6. Module of physical and mathematical training															
MAT 169	Mathematical Analysis I	BD, UC	5	150	1/0/2	105	E	5							
PHY 469	Physics I: Molecular Physics. Thermodynamics	BD, UC	5	150	1/1/1	105	E	5							
MAT189	Linear algebra and analytic geometry	BD, UC	5	150	1/0/2	105	E	5							
MAT 170	Mathematical Analysis II	BD, UC	5	150	1/0/2	105	E		5						

PHY 471	Physics II: Electricity and Magnetism. Nuclear physics	BD, UC	5	150	1/1/1	105	E		5						
MAT171	Mathematical Analysis III	BD, UC	5	150	1/0/2	105	E			5					
MAT110	Ordinary differential equations	BD, UC	5	150	1/0/2	105	E			5					
MAT172	Mathematical Analysis IV	BD, UC	5	150	1/0/2	105	E				5				
MAT448	Equations of mathematical physics	BD, UC	5	150	1/0/2	105	E					5			
M-7. Module of basic training in engineering mechanics and Modeling															
GEN 177	Engineering and computer graphics	BD, UC	5	150	1/1/1	105	E	5							
GEN409	Statics and kinematics	BD, UC	5	150	1/0/2	105	E			5					
GEN198	Dynamics	BD, UC	5	150	1/0/2	105	E				5				
CHE495	General chemistry	BD, UC	5	150	1/1/1	105	E					5			
GEN413	Theory and design of mechanisms and machines	BD, UC	5	150	1/1/1	105	E					5			
GEN199	Engineering thermodynamics	BD, UC	5	150	1/0/2	105	E					5			
GEN414	Numerical methods and programming	BD, UC	5	150	1/1/1	105	E					5			
GEN404	Fluid and gas mechanics	BD, UC	5	150	1/1/1	105	E						5		
GEN405	Solid state mechanics	BD, UC	5	150	1/0/2	105	E						5		
GEN504	Computational hydromechanics and modeling	BD, UC	5	150	1/0/2	105	E						5		
3221	ELECTIVE	BD, CCH	5	150	1/1/1	105	E					5			
GEN447	Modeling and design of mechanical systems	BD, UC	5	150	1/1/1	105	E							5	

GEN448	Modeling and design of thermal systems	BD, UC	5	150	1/1/1	150	E								5
GEN100	Educational practice	BD, UC	2						2						
CYCLE OF PROFILE DISCIPLINES (PD)															
M-8. Module of professional training in engineering mechanics and Modeling															
GEN426	Strength of materials	PD, UC	5	150	1/1/1	105	E				5				
GEN505	Object oriented programming	PD, UC	5	150	1/1/1	105	E							5	
GEN419	Design of machine elements and parts	PD, UC	5	150	1/1/1	105	E						5		
4307	ELECTIVE	PD, UC	4	120	1/1/1	75	E						4		
3223	ELECTIVE	PD, CCH	4	120	1/2/0	75	E						4		
GEN510	Basics of heat transfer	PD, UC	5	150	1/0/2	105	E							5	
GEN421	Introduction to Robotics	PD, UC	5	150	1/1/1	105	E							5	
GEN160	The finite element method in engineering	PD, CCH	5	150	1/1/1	105	E							5	
4309	ELECTIVE	PD, CCH	5	150	1/1/1	105	E							5	
4310	ELECTIVE	PD, CCH	6	180	2/1/1	120	E								6
4311	ELECTIVE	PD, CCH	6	180	2/1/1	120	E								6
4308	ELECTIVE	PD, UC	4	120	0/3/0	75	E								4
GEN500	Industrial practice I	PD, UC	2								2				
GEN501	Industrial practice II	PD, UC	3										3		
M-9. Module of final certification															
ECA108	final examination	FA	8												8
M-10. Module of additional types of training															
AAP500	Military training	DVO	0												
	Total based on UNIVERSITY:							32	29	27	32	30	31	30	29
								61		**59**		**61**		**59**	

Number of credits for the entire period of study					
Cycle code	**Cycles of disciplines**	**Credits**			
		required component (OK)	**university component (BD,**	**component of choice (CCH)**	**Total**
GED	Cycle of general education disciplines	51		5	56
BD	Cycle of basic disciplines		107	5	112
PD	Cycle of profile disciplines		34	30	64
	Total for theoretical training:	***51***	***141***	***40***	***232***
FA	Final certification	8			8
	Total:	**59**	**141**	**40**	**240**